Canadian Space Agency | Agence spatiale canadienne

CANADA'S SPACE POLICY FRAMEWORK

LAUNCHING THE NEXT GENERATION

Canada

MESSAGE FROM THE MINISTER

As Minister of Industry, responsible for the Canadian Space Agency (CSA), I am pleased to present *Canada's Space Policy Framework*.

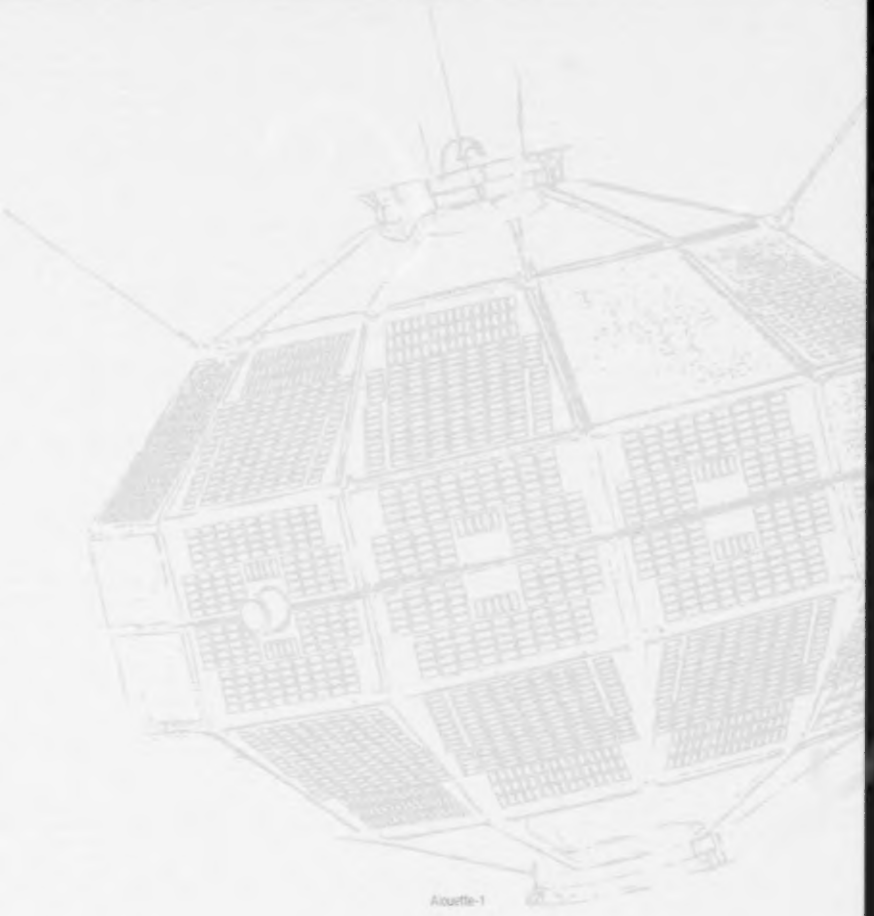
Canada has a proud history in space. From the development of the Canadarm to the great leadership of Commander Chris Hadfield at the International Space Station, Canada has shown time and again that it is a global leader when it comes to space. Whether it is optics and robotics or radar imagery and satellite communications, our companies are renowned for their capability and skill.

Canada's Space Policy Framework is focused on delivering results. Building on Canada's strengths and historic achievements, *Canada's Space Policy Framework* will lay the groundwork to inspire the next generation to pursue studies and careers in science and engineering. It will provide a comprehensive approach to Canada's future in space to ensure our continued commitment to exploration, commercialization and development.

The Canadian space sector is an integral part of Canada's economy and plays an important role in our society. Canada's space industry provides about 8,000 highly skilled jobs and contributes $3.33 billion to Canada's economy every year. We have come to rely on satellites and space expertise not only as part of our everyday lives, but as part of numerous breakthroughs in scientific knowledge and medical treatments. A competitive and innovative Canadian space sector is important for continued job creation and the growth of infrastructure for a knowledge-based economy.

Through this lens, Canada is well positioned to successfully advance our space sector in the 21st century, leading to job creation and growth, enhancement of sovereignty and security, and the advancement of knowledge for generations to come.

The Honourable James Moore
Minister of Industry



Alouette-1

"In the second century of Confederation, the fabric of Canadian society will be held together by strands in space just as strongly as railway and telegraphy held together the scattered provinces in the last century."

– John H. Chapman (1967)
Pioneer of the Canadian Space Program

SPACE AND THE NATIONAL INTEREST

Few endeavours capture the imagination or tax the capabilities of humankind like the exploration and exploitation of space. And few have so quickly made themselves so indispensible.

Since the earliest days of spaceflight, Canada has been at the forefront of space technology. Only five years after the launch of Sputnik 1, Canada became the third nation in space in 1962 with the experimental satellite Alouette-1. When Anik A1 achieved orbit in 1972, Canada became the first country in the world to have its own domestic communication satellite, beaming television signals for the first time to the far North.

Over the years, our expertise in satellite communication and remote sensing has been complemented by global leadership in space robotics. The Canadarm was essential to NASA's Shuttle missions, making possible everything from satellite deployment, capture and repair, to the launch and servicing of the Hubble space telescope. The construction and maintenance of the International Space Station would not have been possible without Canadian robotics: first the Canadarm, then the Canadarm2 and Dextre, which functions as the Space Station's "hand."

CANADARM

When it made its debut aboard the Space Shuttle Columbia on November 13, 1981, the Canadarm instantly became an icon of Canadian technological innovation. Designed to deploy and retrieve payloads in space, the robot arm was integral to the Shuttle program. Five Canadarms were built and flown on NASA's orbiters. They worked flawlessly on 90 Shuttle missions and together spent a total of 944 days in space.

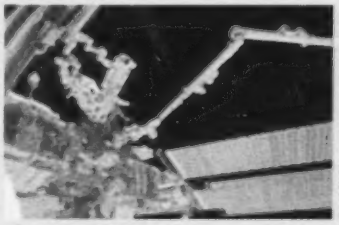
The Space Vision System, developed by Neptec, was used in conjunction with the Canadarm to enhance astronauts' vision while operating the robotic arm in the difficult viewing conditions of space. Neptec's Laser Camera System was also an integral part of the Shuttle's return to flight after the loss of the Columbia orbiter. It was installed on the end of Canadarm's extension boom to inspect hard-to-reach areas on the underside of the Shuttle that could not otherwise be viewed from the Shuttle.

Prime Minister Stephen Harper with Canadian Space Agency astronauts Jeremy Hansen and David Saint-Jacques in front of the Canadarm.

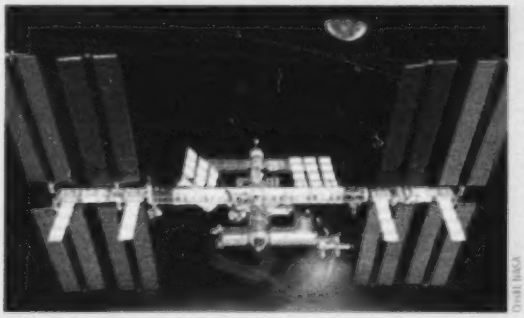
Credit: Office of the Prime Minister (Photo by Jeff Bassett)

BUILDING ON SUCCESS

The International Space Station was literally built in space by Canadian ingenuity. Three-quarters of the structure, which is the size of five NHL hockey rinks, was assembled using the Canadarm2. The 17-metre robotic arm captures, docks and releases visiting spacecraft, while Dextre, the Station's robotic "handyman," conducts routine maintenance, freeing astronauts for their most important task: conducting science experiments to benefit humanity.



Credit: NASA



Credit: NASA

Protecting our national sovereignty, security and safety, Canadian satellites monitor the Earth round the clock, peering through cloud cover, darkness, fog and smoke. Research instruments in orbit probe everything from the complexities of the atmosphere to the Earth's ionosphere – where the atmosphere ends and space begins.

Meanwhile, space systems have become crucial to daily essential services, from banking to the Internet to telephony. Weather forecasting and environmental monitoring, natural disaster warning and response, air traffic control and seagoing navigation, border security, military surveillance and crop management – all of these depend on sophisticated space technologies.

The well-being of Canadians depends on the services the space industry provides. The skills the industry requires are those of an advanced, knowledge-based economy. The jobs it creates are demanding and rewarding. And the profits it generates domestically and through international sales and partnership are a powerful benefit to the national economy.

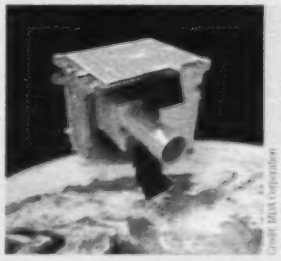
RADARSAT CONSTELLATION MISSION

Scheduled for launch in 2018, the RADARSAT Constellation Mission is a fleet of three sophisticated remote-sensing satellites that will monitor all of Canada's land and ocean territories and 95 per cent of the world's surface. The configuration builds on the success of Canada's previous RADARSAT missions, launched in 1995 and 2007, which have been invaluable in everything from oceanography to forestry, marine surveillance to humanitarian relief efforts. The Constellation Mission will extend those capacities, aiding in ship identification, ice monitoring, oil spill detection and forest firefighting. It will be of particular value in monitoring the Northwest Passage, crucial to safety, security and sovereignty in Canada's North.

Credit: MDA Corporation

SAPPHIRE

Launched in 2013, Sapphire is Canada's first operational military satellite. An orbital traffic controller, Sapphire monitors thousands of pieces of space debris, detects man-made objects in orbit, and provides data to the U.S.-led Space Surveillance Network dedicated to preventing satellite collisions.



Credit: MDA Corporation

It is essential to the national interest, then, that Canada maintain a robust, technologically superior and commercially competitive space industry.

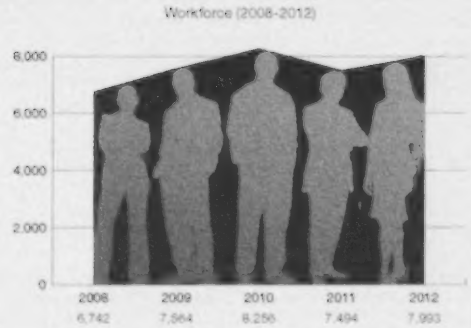
GOVERNMENT ACTION

The Government of Canada recognizes the importance of space and supports the Canadian space sector.

Advancing our national interests through space systems, and promoting our domestic space industry efficiently and with foresight, requires a sure grasp of goals, coherent vision, and coordinated planning. If we are to make the most of our efforts in space, these investments cannot be piecemeal.

Accordingly, the Government of Canada will strategically coordinate its priorities and commitments in space, and put its existing resources to best use. To that end, the Government will adopt a new framework that will provide the foundation for the next phase of our country's space program.

Attuned to current and future developments in space, the policy rests on five core principles, from which four areas of action flow. Together, these provide the framework that will inform decision making on space and the optimum use of government resources.



CANADIAN SPACE INDUSTRY

Canada's space industry employs about 8,000 highly skilled men and women and generated $3.33 billion in revenues in 2012, almost half from exports. The industry is highly concentrated in a few large world-class firms and 200 small- and medium-sized enterprises positioned across the global value chain.

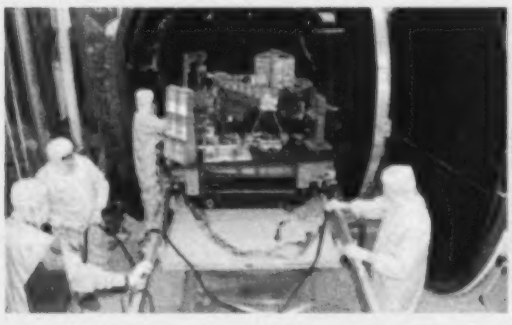
The policy is an integral part of the Government's overarching strategic goals of jobs and growth, sovereignty, security and the advancement of knowledge.

INUVIK GROUND STATION

Inaugurated in 2010, the Government of Canada's Inuvik Satellite Station Facility is poised to become a data hub for global Earth observation stations and Arctic research. Ideally situated to receive data from a growing number of polar orbiting remote sensing satellites, the facility already has dishes operated by the Swedish Space Corporation and the German Space Agency, while the Government of Canada is expanding its infrastructure, under contract with SED Systems Ltd., with a state-of-the-art antenna. The Government of the Northwest Territories has also committed to construct the Mackenzie Valley Fibre Optic Link, which will provide the communications infrastructure to relay data from the Inuvik Station to global centres nearly instantly. At present, data packages have to be put on discs and sent by courier.

JAMES WEBB SPACE TELESCOPE

Successor to the Hubble Space Telescope, the James Webb Space Telescope is set to launch in 2018. It will be the world's premier space observatory of the next decade. Canada's contribution to the James Webb Space Telescope was built for the Canadian Space Agency by COM DEV, while the Canadian science team is led by the Université de Montréal.



CANADA'S NEW SPACE POLICY FRAMEWORK

CANADA'S SPACE POLICY FRAMEWORK

Principles

1. Canadian Interests First
2. Positioning the Private Sector at the Forefront of Space Activities
3. Progress Through Partnerships
4. Excellence in Key Capabilities
5. Inspiring Canadians

Areas for Action

Commercialization	Research and Development	Exploration of Space

Stewardship, Management & Accountability

NEW REALITIES

Space is increasingly congested, contested and competitive. In October 1957, Sputnik 1 was the only artificial satellite in Earth orbit. Today, there are close to 1,100 operational satellites, and more than 22,000 pieces of orbital debris larger than 10 cm have been catalogued. Every G20 nation now has its own satellite system in space, and the emerging economies of China, Russia, India and Brazil have made substantial investments in their national space programs. For the Canadian space industry, that means greater competition even as it presents new customers and markets to be courted.

Meanwhile, the sheer number of objects in orbit makes the global communication infrastructure ever more vulnerable to the escalating risk of satellite collision. Cyber security is threatened by weapons that can disrupt space-borne communication or destroy space assets outright.

Space is also no longer the exclusive preserve of nation-states. There is not only a lucrative and growing market for satellite products and services – global satellite industry revenues are now more than $190 billion a year – but increasingly for private sector launch capability. Today, there are more commercial Canadian satellites aloft than there are systems financed and operated by government agencies or public sector institutions. Space has become a new frontier not only for science but for commerce, and as the economic sphere continues to expand beyond the Earth, new opportunities will emerge for Canada.

FIVE CORE PRINCIPLES

In light of these current and unfolding realities, five essential principles will inform Canadian space activities.

1. Canadian Interests First

National sovereignty, security and prosperity will be the key drivers of Canada's activities in space. Canada's first priority must be to use space effectively in support of these interests.

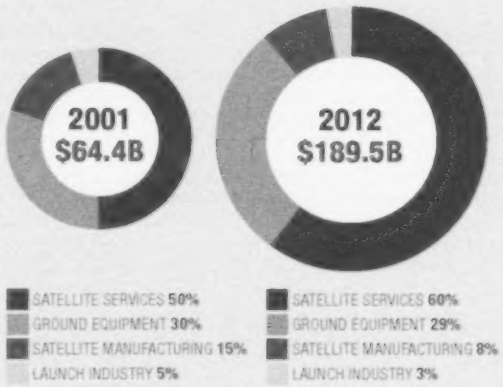
2. Positioning the Private Sector at the Forefront of Space Activities

As space yields ever more commercial opportunities, the Government will focus on:

- Supporting the domestic space industry in the innovation required to bring to market cutting-edge technologies that meet national interests; and
- Utilizing industry where industry has greater capacity, knowledge and skill, or when it can be more efficient and cost-effective.

WORLD SATELLITE INDUSTRY REVENUES BY SEGMENT

Global satellite industry revenues have nearly tripled since 2001, with an average 10% growth per year. In 2012, satellite communications in Canada represented 80% of space sector revenues, which amounted to a total of $2.66 billion.



Credit: Satellite Industry Association

RICHELIEU RIVER FLOODS

In Spring 2011, heavy rain and the melting of a thick layer of snow around the Lake Champlain Basin and the Richelieu River caused floods that affected some 3,000 residences in Quebec's Montérégie region. RADARSAT-2 images were used to assess the damage and guide rescue efforts. Similar images were also used to aid response during the 2013 Calgary floods.

Credit: Public Safety Canada / Photo by Andre Morin

3. Progress Through Partnerships

Space is a shared domain and an expensive undertaking. The Government will look to continue partnerships to share the expenses and rewards of major space initiatives. This will include collaboration with international partners to pool data for mutual benefit and obtain services and technologies that would otherwise be unavailable. At the same time, effective export control and regulatory measures will continue to protect Canadian technologies and data from theft or from falling into the hands of hostile interests.

4. Excellence in Key Capabilities

Canada has had enormous success in a number of areas of space technology, from telecommunications to remote sensing to robotics – expertise that has been invaluable domestically and to our international partners. The Government will continue to support and advance proven Canadian competencies while keeping a close watch on new niches of technological accomplishment.

5. Inspiring Canadians

An advanced, prosperous nation requires an educated, skilled workforce. Space is a highly visible means of motivating young Canadians to pursue careers in science, technology, engineering and math. Working with industry, universities and colleges, the Government will communicate the importance of space in the effort to recruit, support and retain highly qualified personnel.

THE MAPLE LEAF ON MARS

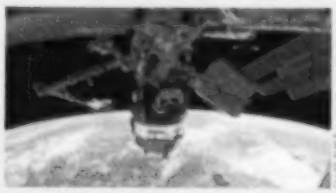
NASA's Curiosity rover on Mars is equipped with the Canadian-built Alpha Particle X-Ray Spectrometer (APXS), which probes the chemistry of rocks and soils to help determine if the Red Planet ever was, or could still be today, able to support microbial life.

The Canadian Space Agency managed the development of APXS with MDA as the prime contractor and the University of Guelph providing scientific direction.

Credit: NASA / JPL-Caltech

DEXTRE

Dextre, the International Space Station's Canadian robotic "handyman," is the only dexterous robot conducting both station maintenance and cutting-edge technology demonstrations. It has made space history by successfully refuelling a mock satellite on the exterior of the station, demonstrating how robots could service and refuel satellites in space to extend their lifetimes and reduce orbital debris.



Credit: NASA

INSPIRING THE NEXT GENERATION

Commander Chris Hadfield in the Cupola module of the International Space Station.

Credit: NASA

Chris Hadfield captured the hearts of Canadians and the attention of the world during his five-month mission aboard the International Space Station. Schools across Canada took part in a national contest to design an experiment for him to perform in space. The winning entry by two students at Lakeview High in Fall River, N.S., examined surface tension in space by wringing a soaking wet washcloth in zero gravity. Meanwhile, more than 7,000 students joined him in a radiation experiment, and over a million learned about biology and physics through mission-related classroom resources.

Canadian Space Agency astronaut Jeremy Hansen bringing space science into the classroom.

Credit: Canadian Space Agency

IMPLEMENTATION

Flowing from these core principles are four avenues of strategic action:

1. Commercialization

Government has clear responsibilities in areas of the public good, such as public safety, national defence, weather forecasting, environmental monitoring and disaster management. The Government will continue to ensure that it has access to the essential information and services it requires. At the same time, it commits to:

- Using the private sector, wherever feasible, to provide the equipment and services it needs;
- Providing the support to ensure that the domestic space industry is robust and globally competitive, especially by assisting in efforts to test and prove the value of new technologies;
- Pursuing consistent business models tailored to areas of activity from research and development (R&D) to space operations and a level of predictability and transparency that industry needs in order to make sound, strategic investment decisions; and
- Working to negotiate international agreements that open market access opportunities for Canadian firms.

2. Research and Development

As a high-technology enterprise, the lifeblood of the space industry is innovation, which in turn rests on research and development. Working with industry and the Canadian space research community, the Government of Canada will encourage further opportunities in R&D and innovation by:

- Increasing support for technology development, especially in areas of proven strength such as robotics, optics, satellite communications and space-based radar, as well as in areas of emerging expertise;
- Coordinating with the granting councils and foundations to ensure that space research resources are leveraged and that space research itself figures prominently in their mandates; and
- Leveraging existing expertise and programs at the National Research Council, Defence Research and Development Canada, Communications Research Centre Canada and the Strategic Aerospace and Defence Initiative – including the newly announced Technology Demonstration Program – to better support the space industry.

TRACKING THE WORLD'S SHIPPING

Credit: Natural Resources Canada

Since 2002, all vessels over 300 tons have been required to broadcast their identity, speed, position and course via the VHF Automatic Identification System (AIS). These transmissions allow ships to know where other vessels are in their vicinity, and so avoid collision. But because of the curvature of the Earth, surface receivers have a range of only about 75 km. The Canadian firm exactEarth, a division of COM DEV, recognized that it could be possible to detect AIS transmissions using satellites in low Earth orbit. In 2008, working with the University of Toronto's Institute for Aerospace Studies, the company launched a satellite to prove that AIS signals could be monitored from space. Two years later, the firm began "mining" the world's AIS shipping data using leased satellite technology. Today, using its own satellites, it tracks some 100,000 vessels around the globe, selling the information to navies, ports and governments. Last year, the company's revenues doubled from $4.8 million to $9.6 million.

NEUROARM

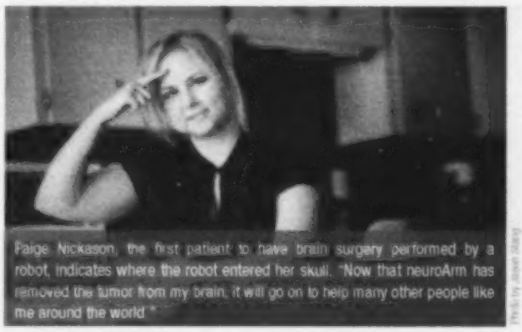


Photo by Jason Kirby

Paige Nickason, the first patient to have brain surgery performed by a robot, indicates where the robot entered her skull. "Now that neuroArm has removed the tumor from my brain, it will go on to help many other people like me around the world."

In partnership with MDA, the manufacturer of the Canadarm, Dr. Garnette Sutherland and his team at the University of Calgary have developed a robotic surgical tool that works with the advanced imaging capabilities of MRI systems. More precise, accurate and dexterous than a human hand, the robot is controlled by the surgeon from a room outside the operating theatre. Since Paige Nickason's groundbreaking surgery in 2008, neuroArm has performed operations on dozens more patients. With investment from the Government of Canada, a "KidsArm" is being developed by Toronto's Hospital for Sick Children in collaboration with MDA, Phillips and other companies for use in paediatric surgery.

3. Exploration of Space

Space exploration has changed our understanding of the universe and driven advances in science and leading-edge technologies. The spectacular success of the multi-nation collaboration that built and now operates the International Space Station – an engineering wonder – heralds a new era for space-based science and for permanent human presence in space. The Government commits to:

- Ensuring that Canada is a sought-after partner in the international space exploration missions that serve Canada's national interests;
- Continuing to invest in the development of Canadian contributions in the form of advanced systems and scientific instruments as part of major international endeavours; and
- Continuing Canada's Astronaut Program so as to have Canadians aboard current and future space laboratories and research facilities.

Canadian Space Agency (CSA) astronaut David Saint-Jacques during a robotics session at the CSA headquarters in Longueuil, Quebec.

Credit: Canadian Space Agency

4. Stewardship, Management and Accountability

Canada's commitments and initiatives in space must not be piecemeal. They have to be part of coordinated policies and strategies. In order to consult all pertinent partners in setting its future priorities, the Government will:

- Establish a Canadian Space Advisory Council, representing the full range of stakeholders in the public and private space domain, chaired by the President of the Canadian Space Agency.

At the same time, the Government will empower a committee chaired by a Deputy Minister to review objectives and expenditures.

FUTURE TRAJECTORY

This policy framework modernizes Canada's space program for the second decade of the 21st century and beyond. It provides clarity with respect to Government priorities and strengthens governance of the space program. Implementation of its core principles will ensure that the Canadian Space Program will be able to deliver the services the Government requires to protect and advance national interests; that industry will find the necessary support to be competitive in global markets; and that academia will be well positioned to conduct the research that will be the foundation of future space missions.

Space remains a harsh and unforgiving environment that tests the capabilities of even the most advanced technologies, spurring the development of ever more sophisticated engineering designs. Our use and understanding of space allows access to the most profound understanding of the cosmos and provides a platform for science to investigate the complexity of Earth as a living planet, even as space becomes increasingly indispensable to the well-being and security of life on Earth. Space is now a growing, multi-billion dollar arena of commercial opportunity.

It is imperative, then, that Canada remain in the vanguard of space research and application. This framework provides the policy blueprint for Canada to do so.